

CLAIMS:

- 1 1. A semiconductor processing system comprising:
 - 2 a) a pod loader;
 - 3 b) a transfer robot;
 - 4 c) a load lock comprising:
 - 5 i) a chamber; and
 - 6 ii) a load lock robot disposed in the chamber; and
 - 7 d) a process chamber.

- 1 2. The system of claim 1 wherein the load lock further comprises:
 - 2 a) a bottom having one or more perforations; and
 - 3 b) one or more lift pins slidably disposed through the one or more
 - 4 perforations.

- 1 3. The system of claim 2 wherein the lift pins are coupled at one end to a linear
- 2 actuator.

- 1 4. The system of claim 1 wherein the load lock further comprises a vacuum pump.

- 1 5. The system of claim 4 wherein the vacuum pump is in fluid communication
- 2 with the chamber.

- 1 6. The system of claim 1 wherein the load lock further comprises an elongated
- 2 substantially rectangular aperture.

- 1 7. The system of claim 6 wherein the load lock further comprises a hermetic
- 2 sealing apparatus adapted to substantially cover the aperture.

- 1 8. The system of claim 7 wherein the hermetic sealing apparatus comprises a slit
- 2 valve.

1 9. The system of claim 7 wherein the hermetic sealing apparatus comprises a gate
2 valve.

1 10. The system of claim 1 wherein the load lock further comprises:
2 a) a cover defining an opening; and
3 b) a lid adapted to substantially cover the opening.

1 11. The system of claim 10 wherein the lid further comprises at least one
2 stabilizing rod disposed through the lid and connected to the cover.

1 12. The system of claim 10 further comprising a transfer assembly adapted to
2 transfer one or more objects to a plurality of positions.

1 13. The system of claim 12 wherein the transfer assembly comprises:
2 a) two pairs of rotational and vertically slidable lifting members each pair
3 being disposed through a pair of bores formed vertically through the lid;
4 b) a wafer lifting element attached to each lifting member at a first end; and
5 c) one or more actuators attached to each pair of lifting members at a
6 second end.

1 14. The system of claim 13 wherein the one or more actuators impart vertical and
2 rotational movement to each lifting member.

1 15. The system of claim 13 wherein each pair of lifting members cooperate to
2 transfer an object to a plurality of positions.

- 1 16. The system of claim 1 wherein the load lock robot comprises:
- 2 a) a symmetrical linkage assembly comprising
- 3 i) a first drive arm having a first end and a second end, the first
- 4 drive arm being rotatable about a first axis at its first end;
- 5 ii) a second drive arm having a first end and second end, the second
- 6 drive arm being rotatable about a second axis at its first end, the first and second drive
- 7 arms being separated by a distance greater than a wafer diameter in their extended
- 8 positions such that a wafer may be vertically transferred between the drive arms;
- 9 iii) a first strut that is connected to the first drive arm at a first pivot
- 10 joint; and
- 11 iv) a second strut that is connected to the second drive arm at a
- 12 second pivot joint, the first and second pivot joints defining a lagging axis; and
- 13 b) a blade pivotally connected to the first strut at a first wrist joint and the
- 14 second strut at a second wrist joint, the first and second wrist joints defining a leading
- 15 axis which remains constantly parallel to, and horizontally displaced from, the lagging
- 16 axis .
- 1 17. The system of claim 16 wherein the blade is extended by the simultaneous and
- 2 synchronous clockwise rotation of the first drive arm and counterclockwise rotation of
- 3 the second drive arm.
- 1 18. The system of claim 16 wherein the blade is retracted by the simultaneous and
- 2 synchronous counterclockwise rotation of the first drive arm and clockwise rotation of
- 3 the second drive arm.
- 1 19. The system of claim 1 wherein the load lock is connected to the process
- 2 chamber.

- 1 20. A load lock comprising:
- 2 a) a chamber;
- 3 b) a load lock robot disposed in the chamber; and
- 4 c) a process chamber attached to the chamber.
- 1 21. The apparatus of claim 20 wherein the load lock further comprises:
- 2 a) a bottom having one or more perforations; and
- 3 b) one or more lift pins slidably disposed through the perforations.
- 1 22. The apparatus of claim 21 wherein the lift pins are coupled at one end to a linear actuator.
- 1 23. The apparatus of claim 20 wherein the load lock further comprises a vacuum pump.
- 1 24. The apparatus of claim 23 wherein the vacuum pump is in fluid communication with the chamber.
- 1 25. The apparatus of claim 20 wherein the load lock further comprises an elongated substantially rectangular aperture providing for fluid communication between the chamber and the process chamber.
- 1 26. The apparatus of claim 25 wherein the load lock further comprises a hermetic sealing apparatus adapted to substantially cover the aperture.
- 1 27. The apparatus of claim 26 wherein the sealing apparatus is a slit valve.
- 1 28. The apparatus of claim 26 wherein the sealing apparatus is a gate valve.

1 29. The apparatus of claim 20 wherein the load lock further comprises:

2 a) a cover defining an opening; and

3 b) a lid adapted to substantially cover the opening.

1 30. The apparatus of claim 29 further comprising a transfer assembly adapted to
2 transfer one or more objects to a plurality of positions.

1 31. The system of claim 30 wherein the transfer assembly comprises:

2 a) two pairs of rotational and vertically slidable lifting members each pair
3 being disposed through a pair of bores formed vertically through the lid;

4 b) a wafer lifting element attached to each lifting member at a first end; and

5 c) one or more actuators attached to each pair of lifting members at a
6 second end.

1 32. The system of claim 31 wherein the one or more actuators impart vertical and
2 rotational movement to each lifting member.

1 33. The system of claim 31 wherein each pair of lifting members cooperate to
2 transfer an object to a plurality of positions.

1 34. The apparatus of claim 20 wherein the load lock robot comprises:

2 a) a symmetrical linkage assembly comprising

3 i) a first drive arm having a first end and a second end, the first
4 drive arm being rotatable about a first axis at its first end;

5 ii) a second drive arm having a first end and second end, the second
6 drive arm being rotatable about a second axis at its first end, the first and second drive
7 arms being separated by a distance greater than a wafer diameter in their extended
8 positions such that a wafer may be vertically transferred between the drive arms;

9 iii) a first strut that is connected to the first drive arm at a first pivot
10 joint; and

11 iv) a second strut that is connected to the second drive arm at a
12 second pivot joint, the first and second pivot joints defining a lagging axis; and
13 b) a blade pivotally connected to the first strut at a first wrist joint and the
14 second strut at a second wrist joint, the first and second wrist joints defining a leading
15 axis which remains constantly parallel to, and horizontally displaced from, the lagging
16 axis .

1 35. The apparatus of claim 34 wherein the blade is extended by the simultaneous
2 and synchronous clockwise rotation of the first drive arm and counterclockwise rotation
3 of the second drive arm.

1 36. The apparatus of claim 34 wherein the blade is retracted by the simultaneous
2 and synchronous counterclockwise rotation of the first drive arm and clockwise rotation
3 of the second drive arm.

1 37. An apparatus for transferring objects between a first position and a second
2 position comprising:

- 3 a) a symmetrical linkage assembly comprising
 - 4 i) a first drive arm having a first end and a second end, the drive
5 arm being rotatable about a first axis at its first end;
 - 6 ii) a second drive arm having a first end and second end, the drive
7 arm being rotatable about a second axis at its first end;
 - 8 iii) a first strut that is pivotally connected to the first drive arm at a
9 first pivot joint; and
 - 10 iv) a second strut that is pivotally connected to the second drive arm
11 at a second pivot joint, the first and second pivot joints defining a lagging axis; and
- 12 b) a blade pivotally connected to the first strut at a first wrist joint and the
13 second strut at a second wrist joint, the first and second wrist joints defining a leading
14 axis remaining constantly parallel to, and horizontally displaced from, the lagging axis.

1 38. A method for transferring wafers between a plurality of positions comprising:
2 a) providing a load lock comprising:
3 i) a chamber; and
4 ii) a first transfer assembly disposed in the chamber, the first
5 transfer assembly occupying a first horizontal plane;
6 b) disposing a wafer onto the first transfer assembly; and
7 c) actuating the first transfer assembly.

1 39. The method of claim 38 wherein actuating the first assembly comprises the
2 steps of:
3 a) lowering the first transfer assembly along the first plane; and
4 b) raising the first transfer assembly along the first plane.

1 40. The method of claim 38 further comprising the steps of:
2 a) providing a second transfer assembly disposed in the chamber, the
3 second transfer assembly occupying a second plane substantially perpendicular to the
4 first plane;
5 b) positioning a wafer on the second transfer assembly; and
6 c) actuating the second transfer assembly.

1 41. The method of claim 40 wherein positioning the wafer onto the second transfer
2 assembly comprises the steps of:
3 a) lowering the first transfer assembly along the first plane from a position
4 above the second plane to a position coplanar with the second plane, the first transfer
5 assembly carrying the wafer;
6 b) depositing the wafer onto the second transfer assembly;
7 c) retracting the first transfer assembly; and
8 d) raising the first transfer assembly.

1 42. The method of claim 41 wherein depositing the first transfer assembly from the
2 wafer, the first transfer assembly comprising a pair of rods diametrically placed rods
3 respecting the wafer and a lifting element coupled to each rod at one end, the wafer
4 gravitationally resting on the lifting elements, comprises the steps of rotating the first
5 transfer assembly about a central axis, such that the lifting elements are removed from
6 one another a distance greater than the diameter of the wafer.

1 43. The method of claim 40 wherein actuating the second transfer assembly
2 comprises the steps of:

- 3 a extending the second transfer assembly along the second plane; and
- 4 b) retracting the second transfer assembly along the second plane.

1 44. A method for transferring wafers between a plurality of positions comprising:

- 2 a) providing a load lock comprising:
 - 3 i) a chamber;
 - 4 ii) a first transfer assembly disposed in the chamber, the first
5 transfer assembly moving along a vertical first plane; and
 - 6 iii) a second transfer assembly disposed in the chamber, the second
7 transfer assembly moving horizontally along second plane perpendicular to the
8 first plane;
- 9 b) positioning at least two wafers onto the first transfer assembly;
- 10 c) lowering the first transfer assembly
- 11 d) positioning a first wafer onto the second transfer assembly;
- 12 e) raising the first transfer plane;
- 13 f) extending the second transfer assembly beyond the load lock, the second
14 transfer assembly carrying the first wafer;
- 15 g) retracting the second transfer assembly;
- 16 h) lowering the first transfer assembly;
- 17 i) removing the first wafer from the second transfer assembly; and
- 18 j) raising the first transfer assembly above the second plane;

1 45. A method for transferring a wafer into and out of a load lock, the load lock
2 comprising a lid and a transfer assembly, the method comprising the steps of:

- 3 a) raising the lid above a transfer plane;
 - 4 b) raising the transfer assembly above the transfer plane;
 - 5 c) positioning a wafer on the transfer assembly;
 - 6 d) lowering the transfer assembly below the transfer plane; and
 - 7 e) lowering the lid below the transfer plane.